ACUTE ŒDEMA OF THE LUNGS SECONDARY TO ETHER NARCOSIS.

BY VICTOR C. PEDERSEN, M.D.,
OF NEW YORK,
Anæsthetist to the Roosevelt Hospital; Anæsthetist and Instructor in Anæsthesia to the New York Polyclinic Medical School and Hospital.

The subject of acute conditions of the respiratory and of the circulatory system during and after anæsthesia of any form is of great importance. The possibility of primary cardiac failure under chloroform is well established as one immediate danger of this anæsthetic. The sequelæ of ether are more likely to be of the secondary type, and to localize in the lungs, usually as lobular pneumonia and infrequently as lobar pneumonia, or in the kidneys, as the various forms of congestion and inflammation. Acute œdema of the lungs is one of the immediate sequelæ of ether narcosis, which, while undoubtedly comparatively rare, must fully be reckoned with.

The following case of it will be of considerable interest on account of the rapidity of its onset, of its long continuation, and of the total recovery of the patient without any after-effects whatever. The case likewise illustrates the extreme importance of examination of the chest in any case of cyanosis, which does not improve when the ordinary precautions and means of restoration of freedom of the upper air-passages have been taken, such as pushing the jaw and pulling the tongue forward and exploring the upper air-passages with the finger. It is in every probability certain that, if the chest of this patient had not been examined instantly with the ear, the œdema would not have been discovered sufficiently early to have rendered medical aid of service.

The incident occurred in the practice of Dr. Charles H. Chetwood, with whose permission and knowledge these notes are published, and whose favor and courtesy therein are hereby acknowledged.

Very full details of the case are given, because absence of many factors in the cases reported in literature makes some of their notices rather unsatisfactory, as the second part of this paper will indicate.

For convenience of reference in the summary with which this paper closes, this case is called Case XV.

History and Examination previous to inducing Anæsthesia.—May 24, 1903; M. H., male; white; about thirty years old; American Jew; merchant; no previous operation under general anæsthetics; addicted to the moderate use of alcohol, such as the member of a wealthy family would employ socially; about five feet seven inches tall; weighs 120 pounds; of reasonable muscular development; of fair nutrition, although somewhat anæmic; of pale to sallow complexion; hair very dark, and general health good; of rather neurotic temperament; showed considerable fear prior to the operation, although able to enter the operating-room, and, unaided, to get upon the operating table. Examination of his heart and lungs by *cursory* auscultation over the front and sides of the chest revealed nothing abnormal. The back of the chest was not examined. The heart-beat was about 100 and quite normal in character. The arteries and veins were without feature, and the nose and throat had not been giving symptoms. No cough was present. Both stomach and rectum were empty. The ante-operative urine was normal. No visceral lesions were known to the operator. The pathologic condition was internal and external piles. The patient received no drugs prior to administration of the anæsthetic, which was the nitrous oxide gas and ether sequence with the Bennett inhaler. The posture was dorsal until the anæsthesia was complete, when the lithotomy position was used.

Induction of Anæsthesia.—About one gallon of gas was employed, that is, the ordinary gas-bag of the Bennett inhaler was filled to distention. Under this anæsthetic the patient became somewhat blue and did not show a full degree of its effect, as was proved by the fact that he underwent considerable ether excitement prior to finally getting under. This excitement was so great that restraint was necessary to prevent the patient from writhing off the table. The writer rarely has seen, except in hospital practice among alcoholics, an individual show as much ether excitement as this man did. After the conjunctival reflex had been abolished, and after the pupils had dilated somewhat, although still reacting to light, the man showed great rigidity of the extensors of the extremities, especially at the knees and elbows. In the effort to overcome this rather obstinate muscular reaction, the anæsthetic was pushed rather hard and fast, and succeeded finally in eliminating the trouble after probably ten minutes' delay, which shows that no undue haste was present. The operation was begun at this stage.

Maintenance of and Condition during Anæsthesia.—The patient, however, did not stay thoroughly under the anæsthetic, in that he showed muscular movements during the operation, insufficiently, however, to interfere with the operator. His color throughout the operation was satisfactory; the pupils were moderately dilated but reacted to light; his pulse was steady at about 90 and his respiration showed the usual ether acceleration. There was throughout the anæsthetization hardly any mucus in the mouth or throat and no audible bronchorrhœa. The operation itself lasted about twenty minutes, and the man was inhaling the anæsthetics about thirty minutes.

The total amount of ether used in the cone was probably four ounces. Unfortunately, the upsetting of the ether-bottle during the stage of excitement made it impossible to measure accurately the amount, but four ounces would be a maximum and three and one-half ounces a minimum estimate. The anæsthetic was withdrawn during the dressing of the patient, and when the dorsal position was resumed, the writer noticed that the man began to get cyanotic, and that his respiration seemed to hesitate, as though he were about to vomit. He was then moved to bed and carefully protected against exposure by being covered, although the day was a rather balmy day (May 24, 1903). The writer stayed with him, noting that he did not vomit and that the cyanosis increased. It was evident that something vital was wrong, and the operator was immediately summoned. By this time (about ten minutes after his return to bed) the man's color was a livid blue and his respirations were beginning to lose their force, although the rate had not materially changed. The writer pushed his finger gently down the patient's throat in order to ascertain whether by some inadvertency he had regurgitated and then inspired a bolus of food, though this seemed highly improbable, because it had been noticed that he had made no œsophageal movements. The writer passed his finger over the epiglottis and into the cavity of the larynx, and as far as he could reach nothing foreign was encountered. He then put his ear to the patient's chest and to his amazement found a very active universal acute œdema of the lungs in progress. The pulse at this moment was of good quality, about 120 beats to the minute, and the pupils were small and slightly active to light. The patient was given a hypodermatic injection of atropine sulphate, a twenty-fifth grain, and the foot of the bed was slightly elevated to an angle of perhaps fifteen degrees with the floor. Dr. Chetwood then instituted very active dry-cupping with wine-glasses over every part of the chest without turning the patient over. At this moment the patient's heart began to fail, and he was given strychnine sulphate, a twentieth grain, through the needle. With great caution the patient was now rolled upon his right side, and while the writer continued on duty at the head holding the tongue and jaw well forward and, while Dr. E. L. Keyes, Jr., kept the bedclothes from pressing on his abdomen, which up to this moment almost alone had been carrying on the respiratory function, Dr. Chetwood continued the cupping all over the back of the chest. Artificial respiration was not employed at this or any other period of the resuscitation. For the next few minutes, while the cupping was continued, the patient's condition remained unaltered, and then the heart began to show signs of weakness again; he was given two syringefuls of whiskey and another injection of strychnine, bringing its total up to a tenth grain. Auscultation of the chest at this moment showed that the râles were beginning to disappear, although the color was still anything but satisfactory and the pulse was still weak. Auscultation of the heart showed pure muscular tones, so that Dr. Chetwood and the writer remarked that hope of his recovery was appearing. Oxygen arrived about this time, and was administered in the usual manner as rapidly as the patient could possibly use it. His color now began to improve slowly, but his pulse was still unsatisfactory. He accordingly received nitroglycerin, a twenty-fifth grain, hypodermatically, from Dr. Keyes. This was at the end of about forty minutes of work upon the patient. In a few moments the great value of this injection appeared and the pulse became much stronger and bounding. When this condition was apparent, the foot of the bed was raised to an angle of forty degrees with the floor. These two details of treatment, the large dose of nitroglycerin and the increase in the inversion of the body, appeared to have accomplished, next after the cupping, more than any other one element of treatment. From that moment on the patient's condition became promising, but the responsibilities of the issue were great enough to warrant a consultation, and accordingly Dr. Walter B. James was called. His physical examination confirmed our findings, viz., that the râles had disappeared from the entire chest with the exception here and there of an occasional "click." He also agreed that the heart, all things considered, had returned to practically its normal condition, but recommended, as a general cardiac support and as a final precaution, that five minims of the tincture of digitalis be administered. This medication was the last the man received. Dr. James also concurred in our prognosis that the patient would recover, and believed that no late lung complications would appear. A few moments after Dr. James's withdrawal the case was left in the writer's hands, and he used the following course of treatment during the next hour and a half: The respiration steadily gained in force and decreased in frequency, until after about one hour the cyanosis of the face, mucous membranes, and finger-nails, which were carefully compared with those of bystanders as standards, had disappeared. Every ten minutes the front and sides of the chest were auscultated, and every twenty minutes the patient was rolled upon his side and the back of the chest was auscultated. At none of these examinations were there râles, but a click (without dulness) was present at inspiration only in the left infraclavicular region, which had totally disappeared by the time Dr. E. L. Keyes, Jr., assumed charge of the case early in the evening. The pulse was at this time steady and regular at about 80 to 90 beats to the minute, of good force and quality, and the heart sounds were firm and muscular. The capillary circulation was efficient wherever and whenever tested by pressure over a bony prominence, to squeeze out the blood and observe its return, for instance, at the finger-nails. The pupils at this stage were moderately dilated and very reactive to light.

The action of the pupil was throughout the case very interesting. At no time was reaction to light totally abolished, and only for brief intervals was the pupil widely dilated, notwithstanding the fact that the patient had received rather a large dose of atropine. The effect of this drug on his respiration and circulation was admitted, but for some unknown reason the pupil showed scarcely any effect whatever. All the drugs administered were from the author's hypodermatic set, always carried for emergencies in solution. It is possible that the atropine had lost its activity on the pupil. This is not likely, because the chemist of the New York Hospital states that solutions of atropine there have not been known to deteriorate, although kept in stock indefinitely in the same kind of rubber-capped half-ounce bottles as the writer always carries. No morphine was at any time administered. Oxygen was inspired by the patient constantly from the time of its delivery at the house up to about one hour after the writer was left alone with him. It was suspended when no further improvement of the color continued, and when his parents admitted that his visage was, as far as they could see, perfectly normal.

Conjunctival reflex was present in a moderate and sluggish degree just before Dr. Chetwood and Dr. Keyes, Jr., left, and in an active degree about a half hour later. No vomiting whatever occurred until some time after the cyanosis was absent, when, without warning, the patient, with a loud, shouting phonation, vomited up a few drachms of mucus, and then answered slowly when called by his mother, and looked in a dazed fashion at the writer when he likewise addressed him. About a half hour after this the patient repeated the vomiting and was able to ask why he had a sore chest.

One extremely interesting feature throughout the convalescence, which was noticed by all present, was that there was at no time any perceptible mucus in the trachea, larynx, or mouth. This was true during the initiation and maintenance of the anæsthesia and the convalescence. Although the patient vomited a little mucus, he coughed up absolutely none. The whole disease process appeared to have found its origin in the air-vesicles, to have reached its acme there, to have run its course there, and to have ended there.

The behavior of the heart was most instructive, because, while the œdema was developing, its action was, broadly speaking, normal, although accelerated, and only after the œdema was so fully established, that the respiratory function had begun to fail, were unfavorable signs from the heart noticed. It seemed probable, therefore, that the œdema was primary in the lungs and not in the right heart.

It matters not which of these two conflicting views be correct—whether the œdema had been primary in the lungs, and only when of sufficient degree to interfere with the circulation had caused cardiac obstruction, and then incipient cardiac failure, or whether the ether had had, as it occasionally does, a selectively depressing action upon the right heart, and after having excited this phenomenon primarily, had set up œdema in the lungs secondarily.

The case is positively the most interesting in the writer's experience in anæsthesia work, and he believes it to be one that is not without clinical importance. There are very few cases of acute œdema of the lungs secondary to ether narcosis reported in literature. F. W. Hewitt (called Case XVI in the closing table of this paper), in his admirable work on "Anæsthetics and their Administration," alludes to a fatal pulmonary œdema in a patient who was the victim of paralysis of the diaphragm, which no doubt in itself was an important causative factor. In the patient under discussion, however, the diaphragmatic respiration was practically the only one at work during the acme of the trouble, so that a parallel between these two subjects cannot be appropriately drawn.

The only other case of œdema of the lungs under anæsthesia, which the author has himself seen, was at the Sloane Maternity Hospital. The subject was a negress, about thirty years old, suffering from eclampsia. *Chloroform* was being administered by him drop by drop with the utmost precision and caution, when prior to circulatory difficulty the œdema began. This patient was saved in exactly the same manner as the writer's male subject, namely, by active dry cupping over the whole chest, first on the front and sides and then, after these had improved, on the back. Veratrum viride was employed to dilate the arteries and quiet the circulatory excitement, which was very marked. No parallel may be drawn between this case and that which has been described, because the eclampsia itself may have been partially or totally the cause of the trouble, and the anæsthesia a mere incident: moreover, ether was not employed at all.

DEDUCTIONS.

The lesson which is to be drawn from this case, which might quite well have been a fatality, is that ether even when given carefully may occasionally cause pronounced and dangerous irritation of the air-vesicles. The man probably received somewhat less than four ounces in from thirty to thirty-five minutes of administration, but the operation was rectal, and resistance to ether was present in his nervous system throughout that time. Consequently, the writer is of the opinion that the œdema was not due to an excessive amount of ether. The œdema may, however, have been induced by the circumstance that when rigidity appeared in the extensor muscles traditions of training and observation were followed in pushing the ether rather rapidly to overcome this complication. It is conceivable that the irritation of the lungs began with this *concentrated* dose of the anæsthetic, although in actual amount it should not be considered proportionately excessive; and although at the moment no unfavorable reaction on the part of the patient was observed, and ten minutes (a proper delay) elapsed before the operation began.

Since this case occurred, the writer has followed the practice in his own work and in the teaching of those he has had the pleasure to meet as instructor, that when any such resistance to the anæsthetic occurs, it is best to wait patiently for it to disappear under a steady and gradually increasing exhibition of the anæsthetic. In this way he does not like to have an operation begin on such a subject much short of ten minutes after the beginning of the inhalation of the drug, whereas under the former procedure the work usually began in less than half this time. He has been rewarded by finding that cases which promised to be troublesome by some such incident at the beginning have followed an anæsthesia with much less difficulty, or none throughout. The principle at stake is that of teaching a boy to swim. If we throw him off the dock into deep water his danger of drowning is extreme, whereas, if we lead him gradually, he may by instinct take care of himself by swimming in water sufficient for that purpose and yet not really beyond his depth.

Another lesson which the writer draws from this case is that of listening to chests after ether narcosis, whether the patient does well or not under it. He has been astonished to find the great number of subjects who show râles in the chest here and there, even when the bronchorrhœa has been immaterial or absent. When the bronchorrhœa is extreme, the noise transmitted down the bronchi is so great that the distinction between the transferred sounds and sounds within the air-vesicles may scarcely be made.

The cases to which attention is drawn, however, are just the opposite of these, namely, where, with a clear throat and free trachea, bubbling sounds are present here and there over the thorax. Putting these two facts together, as the basis of present practice, the writer now takes time, and if necessary plenty of it, to get the patient thoroughly under the ether slowly before he is transferred to the operating table. In the case reported, ten minutes' delay in this process was made; doubtless much longer time would have been better.

In connection with the subject of râles after ether narcosis, the writer has been informed that at the Royal Victoria Hospital in Montreal all subjects of etherization are during convalescence from narcosis protected with a pneumonia jacket: a most wise precaution, simply taken.

A third lesson indicated by the case is that elevation of the foot of the bed has a very great beneficial influence on these patients. Many hold that more harm than good is done to a failing heart by this procedure. With this view the writer disagrees, and believes that the procedure of first elevating the bed slightly and then fully, contributed very materially to the recovery of this patient. In fact, when the second elevation was done, Dr. E. L. Keyes, Jr., remarked that it appeared to have benefited the clinical conditions better than anything else tried. The writer thinks that when difficulties after operations arise, one should consider what the condition of the blood within the patient is, namely, that the great veins of the abdomen, which are capable of holding all the blood of the body, are at the moment, in fact, thus distended, either through the failing heart or the shock of the patient. Against this inert accumulation the heart must work while the arteries themselves contain too little blood to constitute the normal bulk of fluid for propulsion. It is therefore rational to believe and to practise that an elevation of the foot of the bed just sufficient to make the blood flow out of the veins into the heart slowly, to be sure, and under low pressure, so that the intermittent heart action may accommodate it, is exactly the kind of aid which the heart needs to supply it with the blood required to combat this disadvantage of failure, whether from shock or from paresis of its own muscle.

The writer believes, therefore, that this middle view between extreme elevation, which might engorge and stop the heart, and no elevation, which might embarrass it through lack of blood to pump through the arteries, is the correct and rational procedure. He considers the other dictum wrong in refusing to elevate the bed at all, but right in stating that it should not be elevated to the extreme.

Hewitt says in his book: "It is a popular fallacy to imagine that because heart sounds are normal and no visceral disease can be detected, the anæsthesia will run a perfectly normal and straightforward course." This statement agrees perfectly with the writer's experience, which is now considerable, and only reinforces the statement with which he would close this section of the paper, namely, that it is proper to allow the anæsthetist plenty of time to find the pace of his subject in order to run the race of the operation evenly with him. For the purposes of comparison and for the sake of completeness, it has seemed well to include in this discussion similar cases reported in literature. For the following list of cases the writer is indebted in large part to Dr. Edward W. Preble of this city, who very kindly and faithfully looked up the matter.

CASE I.—MORTON (*American Journal of the Medical Sciences*, vol. lxxii, New Series, 1876, page 411). Patient aged nineteen years; male; no history of winter cough or previous chest trouble; general health not vigorous, but not markedly impaired by spinal (probably spondylitis) and knee lesions; no evidence of hereditary disease; operation for ankylosis of the knee, June 3, 1876; narcosis lasted twenty minutes; 2½ to 3 ounces of ether used poured upon a towel, no inhaler as such employed. At the close of the operation, pallor and depression, with the usual postoperative degree of comfort, present; fifteen minutes after operation, and during consciousness, asphyxia developed, most marked in the face and finger-tips; pulse moderately full, about 160; respiration nearly ceased; tongue depressed, and cold water dashed upon the chest; only violent respiratory movements followed; a half-hour later the heart still acting, though labored, and throat filled with bloody mucus; evidences of pulmonary engorgement present; radial artery opened, 8 ounces of blood withdrawn and dry cups applied to the chest; for a time respiration improved, and volume of pulse increased somewhat and fell from 160 to 152; hypodermatic injections of whiskey and carbonate of ammonium failed to revive him from a sinking spell, during which he died after about another hour, that is, about two hours after the operation. The autopsy showed pleuritic effusion, old "infiltrating" pleuritic adhesions scattered everywhere, most marked at right base; œdema of the lungs; deformity of chest; lumbar kyphosis; displacement of abdominal viscera, and fluid in the pericardium. (No note as to renal or encephalic conditions.)

CASE II.—SAUNDBY (*British Medical Journal*, October 13, 1877). Patient aged thirty-five years; female; October 4, 1877, operation for ankylosis of the knee; "about an ounce" of ether; Ormsby inhaler; narcosis normal throughout; recovery from the anæsthesia; one and a half hours later developed cyanosis; failure of the pulse; râles over both lungs. The patient was well wrapped up and carried directly from the operating theatre across an open court to a detached building of the hospital, fifty yards away. Was conscious upon reaching the ward, and spoke to the nurse, who noted nothing unusual in the patient's condition. This procedure of carrying the patient across the court-yard was contrary to the rules of the hospital, and happened in the absence of the house-surgeon. Saundby adds that he cannot state whether or not this exposure had anything to do with the œdema. The autopsy showed effusion into the arachnoid; œdema of the lungs; but otherwise negative.

In the opinion of the author, exposure during the operation at any time, excepting as absolutely necessary and during convalescence from the anæsthetic, in any way, is extremely hazardous. His practice is to direct that the patient be kept covered most carefully and completely, excepting the face for breathing, until complete consciousness is restored, so that the patient may direct the attendants himself as to his feelings of chilliness or warmth. Protection against draughts and changes in temperature is also of extreme importance. All patients perspire slightly, and most patients very freely during the later stages of narcosis and during recovery. Any exposure which tends to check this activity of the skin must be very dangerous to both the lungs and the kidneys. It is probably proper to observe that the exposure noted by Saundby was undoubtedly a very important feature in the case. This opinion is borne out by one experience which the writer has had in the only fatal pneumonia he has had among his anæsthesia patients, which occurred as follows: A perfectly healthy, middle-aged man was under ether fifty minutes for a difficult herniotomy, and consumed two and three-fourths ounces of ether (measured) through the Bennett inhaler, with the upper air-valve open, without any unfavorable symptoms whatever, excepting very free perspiration. The writer was excused by the surgeon to go to another case, and therefore did not see the patient put to bed and could not carry out his usual precautions of protection, as just stated. The surgeon later admitted not only that they were not carried out, but also that a window at the head of the bed and a door at the foot of the bed were left open by the nurse, apparently on the supposition that the hot air of August would do no harm. Congestion of the lungs at once developed, and after three or four days double pneumonia appeared, lobar in type, most severe on the right side, which was the nearer to the open window. The opinion of the medical consultant is quoted in saying that the ether itself had nothing to do with the case, because the pneumonia was lobar in type, and developed so long after the narcosis.

The exposure, in his opinion, on top of the perspiration spoken of, probably was the exciting factor.

It is well to call attention again to the pneumonia jacket used in some hospitals during recovery from ether narcosis.

CASE III.—PARSONS (*Medical News*, March 18, 1882, page 295). Female; aged fifty-four years; normal heart and lungs; reduction of old dislocation of the shoulder, February 16, 1882; narcosis lasted twenty-five minutes; 6 ounces of ether inhaled (method of administration not stated). Recovered from the anæsthesia within five minutes; in one and one-quarter hours cyanosis developed, with death following upon a high degree of pulmonary congestion. Five minutes after the reduction the patient asked for a drink of water, and a little later wished to go home. After attending to a few remaining patients, the doctor left her in charge of a friend and the janitor; after about a half hour she was again seen by the anæsthetist, and an hour later the house-physician was notified that she was dying; he then found her in a cyanosed condition. Two hypodermatic injections of ether were given, 20 minims each, and three or four injections of brandy. Twelve or fifteen dry cups were applied over the chest and other stimulating remedies resorted to; death occurred about one hour after. The autopsy showed heart, liver, and one kidney normal; the other kidney was slightly fatty. The lungs were deeply "congested," thus causing her death.

In the opinion of the writer, the following comment may be offered. This operation was performed in New York City during February. If the janitor and friend referred to were at the patient's house (the original article is by no means definite on this point), the patient was allowed to go home a very short time after recovery from the anæsthetic. This exposure must have been, as in Saundby's case, a very important, exciting feature in the issue of pulmonary congestion, coupled, of course, with the basis laid for the lesion by the ether itself.

CASE IV.—HUTCHINSON (*Lancet*, 1885 vol. i, page 178). Male; aged sixty-two years; January 14, 1885, for reduction of old shoulder dislocation; carried out in the Out-Patient Department of the London Hospital in the winter-time. Ormsby inhaler used, air-cap slightly open; induction of anæsthesia within the usual time. The reduction of the dislocation was not satisfactory, so that the anæsthesia was resumed for a short time with whatever ether was in the inhaler. The patient now began to look pale and to breathe very feebly; brandy hypodermatically was administered over the heart. The tongue was drawn out and artificial respiration was begun. Electricity was used to the nerves of the neck; duskiness of the skin increased and efforts at artificial respiration failed of result, although continued for a half hour. Upon the removal of the inhaler the second time, there was at first no anxiety; there had been struggling during the first administration, but none during the second. No food had been taken, and no lung trouble was admitted by the patient, although he was evidently short of breath. The autopsy showed emphysema of the lungs, congestion, bronchitis, and mucus in the bronchi; the lower lobes did not contain much air, and there was more œdema in the upper parts. The trachea was congested and contained frothy mucus; the heart was fatty, the pericardium was adherent, the other organs were healthy. The pathologist thought death was due to fatty heart and emphysema. The patient had not been well for some time before, and had fainted not long before applying at the hospital.

This operation also seems to have taken place in the winter-time. It is possible that the exposure, unavoidable in an Out-Patient Department, may also have been a cause of the œdema.

CASE V.—JACOB (*British Medical Journal*, 1885, page 887), in a table of deaths under anæsthetics, notes the following: Female; aged sixty-four years; ovariotomy; death seventeen hours after operation with symptoms of pulmonary œdema; no autopsy.

CASE VI.—E. GURLT (*Archiv für klinische Chirurgie*, Band xlviii, page 273), quoting Trendelenburg. Female; aged thirty-five years; cholecystenterostomy; narcosis one and a half hours; normal but with appreciable salivation and repeated vomiting (method of administration omitted); upon coming out of the ether loud mucous râles were heard in the trachea and bronchi over both sides; the symptoms grew worse; death occurred thirty-two hours after narcosis, apparently of œdema of the lungs. On the next day after the operation the condition was difficulty in expectoration on account of the abdominal wound. Trendelenburg adds that it is doubtful whether the ether caused the death; the patient had carcinomatous lymph-nodes in the abdomen, perhaps secondary to a tumor of the pancreas. She may have suffered from pulmonary metastases. No autopsy was allowed.

CASE VII.—GRANT MORRIS (Proceedings of the Society of Anæsthetists, *Lancet*, May 7, 1898) reported as follows: Female; thirty years old; pain in the region of the left kidney; cachexia; trace of albuminuria on admission, but none on the day of operation; exploratory laparotomy; ether from Clover's inhaler, not pushed, taken normally; slight cyanosis; much frothing at the mouth towards the end of the operation. No alarm occasioned. Patient taken from the table after sixty-five minutes still cyanosed; respiration unimpeded but shallow and sighing; appeared about to vomit; no evidence of obstruction to breathing; conjunctival reflex present; pupils equal and contracted. In fifteen minutes became ashy pale; first the respiration and then the pulse ceased; artificial respiration brought away much frothy, watery secretion. The autopsy showed lungs full of frothy secretion. Death due apparently to failure of respiration from acute œdema of the lungs set up by the ether. There was no hemorrhage into the medulla.

CASE VIII.—In the discussion at this meeting, SILK said he had witnessed a similar case; much ether had been inhaled; the lungs were water-logged from acute œdema. He stated that in his opinion artificial respiration is dangerous in these cases.

CASE IX.—At the same meeting, DR. STARLING thought that renal diseases might be a feature in producing acute œdema of the lungs, and instanced a case supporting this view.

CASE X.—POPPERT (*Deutsche medicinische Wochenschrift*, 1884, 37, pages 719 to 722). Male; forty-six years old; farm-hand; previous good health; no cough; long-standing alcoholic habit, moderate in degree for one and a half years previous to admission. Admitted May 20; right inguinal hernia in the early stages of irreducibility and inflammation; medicinal treatment until May 31 . Ether narcosis; radical operation for irreducible inguinal hernia; small abscess in the sac and recent adhesions; no perforations; wound packed; no bowel reduced into the abdomen. Narcosis lasted thirty minutes; 130 cubic centimetres of ether used; Czerny's, then Juillard's mask employed; anæsthesia slight; subconscious movement; slow, strong pulse; slight cyanosis; regular respiration; one emesis of gastric mucus; mucus râles toward the close of narcosis; prompt recovery of consciousness; no immediate complications; after more than an hour increasing dyspnœa with loud râles, frequent cough, and much mucous sputum appeared. The pulse was so strong that no stimulants were needed, and the diagnosis was rendered of unusual accumulations of mucus, which the patient, being fully conscious, was expected to cough up for himself. (There is no note of any physical examination of the chest.) Rapid heart failure with progressive cyanosis, accompanied by large quantities of blood-stained mucus in the nose, mouth, and throat, appeared, and death supervened during manifest œdema of the lungs.

The autopsy was held on the day of death and showed generalized peritonitis with recent adhesions, two intra-abdominal abscesses, hernial canal admitted several fingers. Contents of sac adherent; normal heart; slight aortic sclerosis; lungs slightly emphysematous, very markedly œdematous; the trachea and bronchi were filled with blood-stained, watery mucus. The other organs were normal. The cause of death was assigned as acute œdema of the lungs.

No note is given of treatment directed against the œdema of the lungs, hence no one may say whether or not it was suspected until its discovery was too late to be of value to the patient.

CASE XI.—RIEDEL, quoted by E. Gurlt (*Archiv. f. klin. Chir.*, xlviii, page 264). Male; forty-four years old; admitted November 11, 1893; previously healthy, excepting abdominal pains progressing steadily and not relieved by lavage; no jaundice; powerful, well-nourished man; normal temperature; normal urine; emphysema; normal heart; tenderness over gall-bladder. Operation, November 12, 1893; exploratory laparotomy under morphine and ether (quantity and inhaler not stated); narcosis forty-five minutes long, with great cyanosis; recovery prompt, with mental disturbance; pulse 80, regular, full, strong; rather feeble respiration.

November 13, about the same general condition, excepting increased mental disturbance; no vomiting; no abdominal pain; spontaneous urination; in the afternoon, pulse 96, weaker than before, but still rather strong; food refused; death thirty-three hours after operation. Autopsy on November 14 showed emphysema, œdema, early infiltration on the surfaces of the lungs; atheroma of aorta, shortening of one aortic valve, narrowing of coronary arteries, slightly fatty heart.

Gurlt considers this case one in which œdema of the lungs was important. No note is given of the manner in which the ether was given, and none of measures adopted to combat the œdema. The latter fact, and the absence of statement of signs of the œdema during life, raise the question whether, after all, this condition was so etiologic as Gurlt in his table describes.

CASE XII.—J. KAARSBERG (*Centralbl. f. Chir.*, 1896, page 337), June 16, 1889; female; ovariotomy; anæsthesia forty-five minutes long; 150 cubic centimeters of ether (inhaler not stated); normal narcosis; cessation of respiration during dressing; easy artificial restoration, but prompt recurrenceof cessation after a few spontaneous respirations; for seven and one-half hours artificial respiration was continued, then death; pulse continued strong up to within an hour of death, when râles and cyanosis demanded venesection; no return to consciousness; autopsy showed œdema of lungs; fatty heart; senile atrophic kidneys (brain examination for lesions of the fourth ventricle not reported).

CASES XIII and XIV.—ROSING-HANSEN (quotation, *Centralbl. f. Chir.*, 1896, page 338) reports two cases of fatal œdema of the lungs secondary to ether narcosis for placenta prævia. Great anemia was present in each instance, so that the author raises the question as to whether the anemia or the ether was the more potent factor, and concludes that the ether was the cause, because anemia cannot be regarded as having that relation to œdema of the lungs. No report is given of means adopted to treat the œdema.

CASES XV and XVI are the author's patients with piles and eclampsia respectively, discussed previously.

CONCLUSIONS.

Mere tabulations of the important elements in monographs of this character very rarely have definite value. It is hoped, however, that the grouping into paragraphs of the rather essential details will be instructive and serve as a suitable termination of the paper.

1. The *quantity of ether* used in six cases in which this particular is stated averaged 4 ounces. The extremes were

1 ounce and 6 ounces. In Case VIII "a large amount" was used. No quantity is given in IV, V, VI, VII, IX, XI, XIII, and XIV. The quantity of drug employed is, provided the limits of intoxication are not approached, of comparatively little moment. The best measure of the amount of ether to be used is the patient himself as regards his symptoms and not a glass graduate. Thus it is certainly possible to overwhelm a patient with a few ounces, which would scarcely affect a very similarly constituted individual. The proper procedure is steadiness of increase of the concentration and deliberation in the presence of even slight difficulties. Incautious haste (merely to save time which should properly be devoted to securing the patient's safety) and rapid concentration of fumes mark the course of danger.

2. The *form of inhaler* was the bag-type (improperly called "closed" method, properly called "regulable" method, because the valves allow of perfect adjustment to the indications) in II, IV, VII, XV, no inhaler at all as such in I, and is not stated in III, V, VI, VIII, IX, XI, XII, XIII, XIV. Czerny's and Juillard's masks were used in X, whose precise nature cannot be determined through the New York dealers.

The control of conditions by means of the valves and the warming of the ether fumes by means of the bag make the regulable or bag inhalers by all means the safest and best. In the hands of the indifferent, however, undue concentration of fumes may be rapidly and intensely attained. No one therefore should begin to employ these inhalers without careful study of their mechanism first, and, second, instruction from an expert. It is possible by haste, carelessness, and inaptitude to render the position of a patient in any narcosis one of danger, no matter what inhaler is employed.

3. *Recovery of consciousness or "from the ether"* is stated to have been complete in I, II, III, X, XI, XV, incomplete in VI, and is not noted at all in IV, V, VII, VIII, IX, XII, XIII, XIV. It is possible to argue from the number of prompt restorations of consciousness that true intoxication with ether is not by any means an essential to the œdema, and

it is also fitting, therefore, to repeat that manner of administration and other circumstances in the management of the narcosis and convalescence are the etiologic factors.

4. The *nature of the operation*, probably of no moment, excepting when the air passages themselves are being invaded, was reduction or other invasion of joints in I, II, III, IV, laparotomy in V, VI, VII, XI, XII, herniotomy in X, midwifery (pacenta prævia) in XIII, XIV, not stated in VIII and IX, piles in XVI. It is well to note that two (III and IV) of the joint cases were treated in out-patient departments, where exposure to cold is almost unavoidable, and one (II) was confessedly very greatly subjected to check of perspiration and change of temperature. It is thus worth while to repeat that too little attention to this protection is given by surgeons, assistants, nurses, and other attendants. Operations under ether in out-patient departments are probably very dangerous on account of the conditions of temperature and ventilation.

5. The *average duration of life after the operation* was eleven and three-fourths hours in seven cases; the extremes were one and one-third hours and thirty-three hours. Unsatisfactory or no statement on this point is given in IV, V, VIII, IX, XI, XIII, XIV.

6. *Age* and *sex* are, as in all narcosis, of little importance excepting as they are concerned in the diseases most common to the various periods of life and to the two sexes. The average of 12 stated ages of these patients was 41 years and the extremes were 19 and 64 years; the females numbered 7 and the males 5. Age and sex are not given in 4 reports.

7. *Previous good health* is stated to have existed in Cases X, XI, and XV; ill health in reports I, IV, VI, XIII and XIV, while notes on this point are wanting in histories II, III, V, VIII, IX, and XII. This detail does not take in autopsy findings.

8. The *forms of ill health, independently of post-mortem examinations*, are given as " not vigorous" in I; evident dyspnœa in IV; carcinomatous lymph-nodes secondary to cancer of the pancreas in VI; nephritis in VII (?), IX; anæmia sec-

ondary to hæmorrhage of placenta prævia in XIII and XIV; and piles in XV.

The reporter of XIII and XIV thinks anæmia of little importance in these cases. The writer, however, while instructing the members of the house-staff at the Roosevelt and Polyclinic Hospitals never has seen an anæmiac do well if the ether or chloroform be carelessly handled. The depression of the anæmia multiplies susceptibility to all drugs, and thus that to the dangers of anæsthetics.

9. The *autopsy findings* were as follows: Disease of the pericardium, heart, arteries, and valves, was in some form present in I, IV, X, XI, XII; disease of the pleura, lungs, trachea, and bronchi (other than œdema) was in some degree proved in I, IV, X, XI; disease of the kidneys of distinct form was established in III, XII; disease of the abdominal viscera, including hernia and peritonitis, but excluding the kidneys, was in some type present in I (displacement by deformity) and X. Lesions of the brain were found on autopsy in II, pronounced absent in VII, and were not sought, though possibly present, in XII.

10. *Œdema of the lungs* was diagnosed as a distinct entity by physical examination and clinical signs in I, XV, II, III, V, VI, IX, X, XII, XIII, XIV; by autopsy in III, IV, VII, X, VIII (by inference), XI.

Œdema of the lungs is regarded as the chief cause of death in II, III, VII, and may possibly have been such cause in I, IV, VIII, IX, X, XI, XII, XIII, XIV. Notes in V and VI are too fragmentary for classifying.

Œdema of the lungs though present was not fatal in XV.

11. No *treatment* is stated in II, V, VI, IX, XI, XIII, XIV. *Treatment of the œdema* was venesection in I and XII; dry cupping in I and XV; free cardiac and respiratory stimulation in I, III, IV, and XV; artificial respiration in IV, VII, XII; electricity to the nerves of the neck in IX; stimulation of pulse was omitted intentionally in IX; artificial respiration is regarded as dangerous in VIII; an opinion concurred in by the writer, because it serves only to pump the serum from the ves-

icles into the bronchioles and bronchi, where it simply clogs the main channels of the air current. Elevation of the foot of the bed moderately at first and then fully is stated to have been used only in XV. Stimulation of the pulse with arterial dilatation is stated to have been employed only in XV. Dilatation of the pulse with veratrum viride was carried out only in XVI, the case of eclampsia.

The deductions from these facts which may be drawn are that the best treatment of the œdema is active dry cupping, and of the circulation in asthenic cases is free use of nitroglycerin and strychnine, elevation of the foot of the bed moderately at first, later fully, and of the circulation in sthenic cases is venesection or judicious use of the aconite group.

The *best prophylactic measures* are certainly deliberate uniform administration and the most adequate possible protection of the patient from draughts and changes of temperature during the stage of perspiration in convalescence.